

## Assesment of effect of water quality on efficacy of some organophosphorus pesticides in controlling *Spodoptera litura*, Fabricius

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### Abstract

A laboratory experiment was conducted at the Department of Entomology, N. M. College of Agriculture, N.A.U., Navsari to assess the effect of water quality on efficacy of three organophosphorus pesticides viz. monocrotophos, chlorpyrifos and quinalphos against third instar larvae of *Spodoptera litura* revealed that water EC and efficacy of pesticide have positive relationship i.e. water EC increases the larval mortality also increased. Higher the EC (16 EC, 12 EC), tube well, canal and distilled waters were found equally effective against larvae of *S. litura*. While, calcium level of water and efficacy of pesticide have negative relationship i.e. level of calcium increases in water, efficacy of monocrotophos, chlorpyrifos and quinalphos decrease. The tube well, distilled and canal waters along with insecticides had recorded higher mortality as compared to different calcium water treatment.

**Keywords:** Water quality, pesticide, *Spodoptera litura*

### Introduction

*Spodoptera litura* Fab. is popularly known as “Prodenia” among farmers in Gujarat. The insects belonging to the genus *Spodoptera* are major agricultural insect pests throughout the world. Amongst them, leaf eating caterpillar, *Spodoptera litura* Fab. is one of the important lepidopterous noctuids.

*S. litura* is an important polyphagous, ubiquitous, multivoltine crop pest of National status in India. Mossua et. al (1960)<sup>[1]</sup> have reported this pest, feeding on 112 crop species and some species of weeds. It enjoys wide distribution and besides India it is reported from Burma, Thailand, Philippines, China, Japan, Vietnam, Indonesia, Australia, Korea, Iran, Egypt, Bahrain, Fiji and Formosa.

Crop production has been revolutionized under plant protection umbrella. Water is the only liquid normally used as carrier in spraying (plant protection programme) due to its availability, cheapness and non-phytotoxicity. Despite these economic advantages, some soluble salts are present in the water. The nature and extent of salt, however, depends upon the source of water. Farmers of different areas having different source of water. The soluble salts present in water may have some effect on efficiency of pesticides used in plant protection programme.

### Materials and Methods

The different EC waters were prepared by dissolving the salts of NaCl and CaCl<sub>2</sub> as per the details given in Table 1. The required quantities of salts were dissolved in 500 ml of distilled water. After the complete ionization of added salts, the EC of water was measured with the help of EC meter.

The different calcium waters were prepared by dissolving the salts of NaCl and CaCl<sub>2</sub> as per table 2. The required quantities of salts were dissolved in 500 ml of distilled water. After the complete ionization of added salts, the EC of water was measured with the help of EC meter.

The required concentrations of each organophosphorus pesticide were prepared in 50 ml of different quality waters. After addition of pesticides in different quality waters, the

transmittance of such waters was measured at 540 nm wave length with the help of spectrophotometer.

Two ml solution of each treatment was applied with the help of Potter's Tower on leaves of castor placed in petri dishes (15 cm diameter). Petri dishes with treated leaves of castor were kept under ceiling fan to evaporator water on the leaf. After complete evaporation of the water on the treated leaves were transferred to the glass jar (15 cm height x 10 cm diameter). Ten, third instar larvae were released in each glass jar and they were allowed to feed on treated food material for 24 hrs. Fresh untreated leaves of castor were provided daily after 24 hrs. of the treatment. Mortality counts were recorded at 24<sup>th</sup>, 48<sup>th</sup>, 72<sup>nd</sup> hr. and 7<sup>th</sup> day after treatment. The mortality percentage was calculated and the data thus obtained were statistically analysed after subjecting angular transformation.

**Table 1:** Different EC and constant calcium

Sr. No	EC (dS/m) levels of water	NaCl		CaCl <sub>2</sub>	
		me/lit	g/500 ml	me/lit	g/500 ml
1	Distilled (0.03)	-	-	-	-
2	Canal (0.33)	-	-	-	-
3	Tube well (1.50)	-	-	-	-
4	4	10	0.3	30	1.103
5	8	50	1.5	30	1.103
6	12	90	2.8	30	1.103
7	16	130	4	30	1.103

**Table 2:** Constant EC and Different calcium

Sr. No	EC (dS/m) levels of water	NaCl		CaCl <sub>2</sub>	
		me/lit	g/500 ml	me/lit	g/500 ml
1	Distilled (0.03)	-	-	0.024	-
2	Canal (0.33)	-	-	1.52	-
3	Tube well (1.50)	-	-	1.92	-
4	4	30	0.876	10	0.3
5	4	20	0.584	20	0.736
6	4	10	0.292	30	1.104
7	4	-	0	40	1.427

dS/m = descil Simen/meter, g = gram, me = milli equivalent

**Results and Discussion**

The results (Table 3, Fig.1) revealed that there was significant difference in per cent mortality at 24 hrs, 48 hrs and 7<sup>th</sup> day of observations. At 24 hrs after the treatment, the 16 EC water gave 41.35 per cent mortality and it was significantly superior over rest of the treatments. The 12 EC water ranked second in effectiveness with 37.99 per cent mortality. While, 8 EC water gave 33.18 per cent mortality and it was at par with canal water (control-2) which recorded 30.06 per cent mortality. Tube well water (control-3) gave 28.54 percent mortality and it was at par with canal water (30.06 per cent). The treatments of 4 EC water and distilled water (control-1) gave 23.92 and 25.42 per cent mortality of *S. litura*, respectively.

At 48 hrs of post treatment, 16 EC water recorded highest mortality 53.14 per cent and it was at par with 12 EC water (49.3 per cent). The 8 EC water registered 47.78 per cent mortality which was at par with canal water (46.29 per cent). The 4 EC water recorded 41.23 per cent mortality and remained at par with tube well water and distilled water. After 72 hrs of treatment, per cent mortality ranged from 70.29 to 80.65 per cent but there was no significant difference among the treatments.

On 7<sup>th</sup> day after treatment, 16 EC, 12 EC, tube well, canal and distilled waters were found equally effective and were statistically at par with one another and recorded 99.5, 97.16, 98.00, 99.5 and 98.61 per cent mortality, respectively. The 8 and 4 EC waters recorded were at par with each other and registered 91.55 and 88.50 per cent mortality, respectively.

The effectiveness of pesticides in descending order after 7<sup>th</sup> day was Monocrotophos 0.04 % (99.33 per cent) > Chlorpyriphos 0.04 % (96.39 per cent) > Quinalphos 0.05 % (94.18 per cent), respectively (Table 4, Fig. 2).

Thus, from the above results it can be said that as the EC of water increases the larval mortality of *S. litura* also increases i.e. positive association.

**Table 3:** Effect of Different EC and Constant calcium waters

Sr. No	Treatments	Cumulative mean per cent mortality after indicated period			
		24 hrs	48 hrs	72 hrs	7 days
1	Distilled water	*30.28 f	38.84 c	58.98 a	83.22 a
		** (25.42)	(39.33)	(73.44)	(98.61)
2	Canal water	33.25 cd	42.87 b	58.98 a	86.14 a
		(30.06)	(46.29)	(73.44)	(99.55)
3	Tube well water	32.29 d	40.94 c	62.90 a	81.86 a
		(28.54)	(42.89)	(79.25)	(98.00)
4	4 EC water	29.28 e	39.95 c	56.97 a	70.18 b
		(23.92)	(41.23)	(70.29)	(88.50)
5	8 EC water	35.17 c	43.73 b	58.98 a	73.10 b
		(33.18)	(47.78)	(73.44)	(91.55)
6	12 EC water	38.05 b	44.79 ab	63.90 a	80.30 a
		(37.99)	(49.63)	(80.65)	(97.16)
7	16 EC water	40.02 a	46.80 a	61.44 a	86.14 a
		(41.35)	(53.14)	(71.14)	(99.55)
	S.Em. ±	1.11	1.55	1.96	2.38
	C.D. at 5 %	3.27	4.57	NS	7.00
	C.V.%	7.99	8.95	7.95	7.27

\* Figures outside the parentheses are arcsine transformed value

\*\* Figures in the parentheses are re- transformed value

**Table 4:** Efficacy of three organophosphorus pesticides in different EC waters

Sr. No	Treatments	Cumulative mean per cent mortality after indicated period			
		24 hrs	48 hrs	72 hrs	7 days
1	Monocrotophos 0.04 %	*42.08	47.98	61.35	85.30
		** (44.91)	(55.19)	(77.01)	(99.33)
2	Chlorpyriphos 0.04 %	41.63	51.71	65.35	79.05
		(44.13)	(61.60)	(82.60)	(96.39)
3	Quinalphos 0.05 %	18.43	27.98	54.22	76.05
		(9.99)	(22.01)	(65.82)	(4.19)
	S.Em. ±	0.73	1.02	1.28	1.56
	C.D. at 5 %	2.14	2.99	3.77	4.58
	C.V.%	7.99	8.95	7.95	7.27

\* Figures outside the parentheses are arcsine transformed value

\*\* Figures in the parentheses are re- transformed value

The results (Table 5, Fig.3) revealed that distilled water (control-1), canal water (control-2) and tube well water (control-3) gave 30.06, 28.54 and 25.42 per cent mortality of *S. litura*, respectively.

After 48 hrs of post treatment, the 10 mg calcium water gave highest mortality of *S. litura* (43.13 per cent) but it was at par with the treatment of canal (42.95 per cent), tube well (41.23 per cent)

and distilled waters (39.33 per cent). The 20, 30 and 40 mg Ca waters registered 36.00, 23.76 and 15.44 per cent mortality, respectively.

At 72 hrs and 7<sup>th</sup> day after treatment, per cent mortality of *S. litura*, decreases with increase in calcium content of water. The tube well, distilled and canal waters (control 3, 1 and 2) recorded higher mortality as compared to rest of the treatments.

**Table 5:** Effect of Constant EC and Different calcium waters

Sr. No	Treatments	Cumulative mean per cent mortality after indicated period			
		24 hrs	48 hrs	72 hrs	7 days
1	Distilled water	*30.28 ab	38.84 a	58.98 ab	83.22 a
		** (25.42)	(39.33)	(73.44)	(98.61)
2	Canal water	33.25 cd	40.95 a	58.98 ab	86.14 a
		(30.06)	(42.95)	(73.44)	(99.55)
3	Tube well water	32.29 a	39.95 a	61.79 a	81.86 a
		(28.54)	(41.23)	(77.66)	(98.00)
4	4 EC water 10	28.17 b	41.05 a	56.97b	63.90 b
		(22.29)	(43.13)	(70.29)	(80.65)
5	4 EC water 20	23.69 c	36.87 b	48.87 c	55.87 c
		(16.03)	(36.00)	(56.73)	(68.52)
6	4 EC water 30	18.22 b	29.17 c	43.02 d	50.83 d
		(9.78)	(23.76)	(46.55)	(60.11)
7	4 EC water 40	12.59 e	23.14 d	35.10 e	44.98 e
		(4.83)	(15.44)	(33.06)	(49.97)
	S.Em. ±	1.82	1.83	2.17	1.29
	C.D. at 5 %	5.38	5.39	6.37	3.78
	C.V.%	17.58	12.57	10.22	4.73

\* Figures outside the parentheses are arcsine transformed value

\*\* Figures in the parentheses are re- transformed value

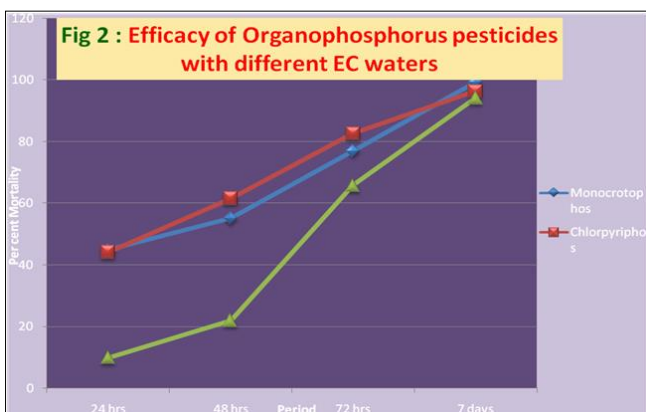
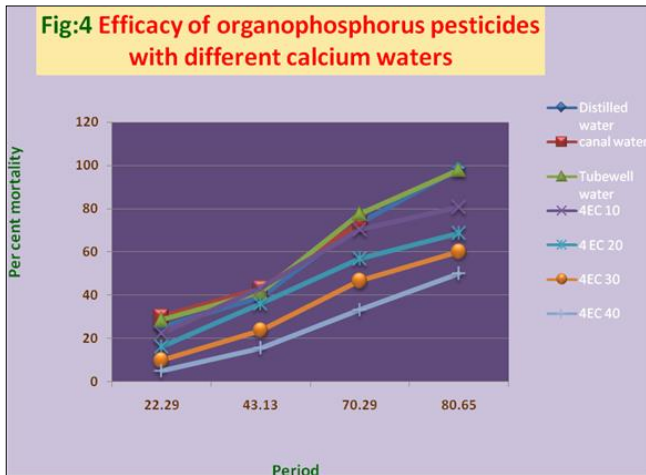
**Table 6:** Efficacy of three organophosphorus pesticides in Different calcium waters

Sr. No	Treatments	Cumulative mean per cent mortality after indicated period			
		24 hrs	48 hrs	72 hrs	7 days
1	Monocrotophos 0.04 %	*30.18	36.94	52.40	72.33
		** (25.17)	(36.12)	(62.77)	(90.78)

2	Chlorpyrifos 0.04 %	31.60	45.79	57.51	65.26
		(27.46)	(51.38)	(71.46)	(82.49)
3	Quinalphos 0.05 %	14.67	24.40	45.76	62.47
		(6.41)	(17.07)	(51.33)	(78.64)
S.Em. ± (P)		1.20	1.20	1.42	0.80
C.D. at 5 % (P)		3.52	3.53	4.17	2.48
C.V.%		17.58	12.57	10.22	4.73

\* Figures outside the parentheses are arcsine transformed value

\*\* Figures in the parentheses are re- transformed value



The effectiveness of pesticides after 7<sup>th</sup> day in descending order was Monocrotophos 0.04 % (90.98 per cent) > Chlorpyrifos 0.04 % (82.49 per cent) > Quinalphos 0.05 % (78.64 per cent), respectively (Table 6, Fig. 4).

Further it was observed that efficacy of organophosphorus pesticides viz., Monocrotophos, Chlorpyrifos and Quinalphos decrease as the level of calcium in water increases. This indicates negative relationship between efficacy of pesticides and Ca levels in water.

**References**

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